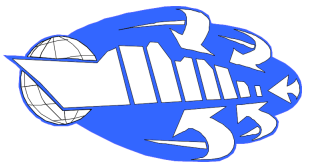




***SMMOA
Supply,
Maintenance,
Monitoring
Open
Architecture***
Presented by
David Perrussel
SMMOA Project Lead
***October 23,
2003***

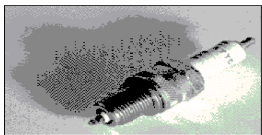


Open Systems Architecture



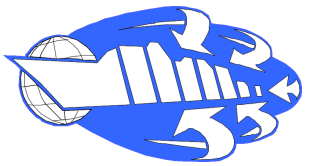
- The **Open System Architecture (OSA)** concept was developed by the **computing industry** in the 1970's and 1980s to help compatability among vendors, thus reduce costs.
- Involves defining an architecture and “**open standards**” for interfaces within that architecture
- Multiple companies are then free to build (innovative) products that “plug into” open standard
- **Widely used throughout Information Technology (IT) Industry**

Examples of OSA Interfaces



“Plug and Play” Storage Devices for common interface

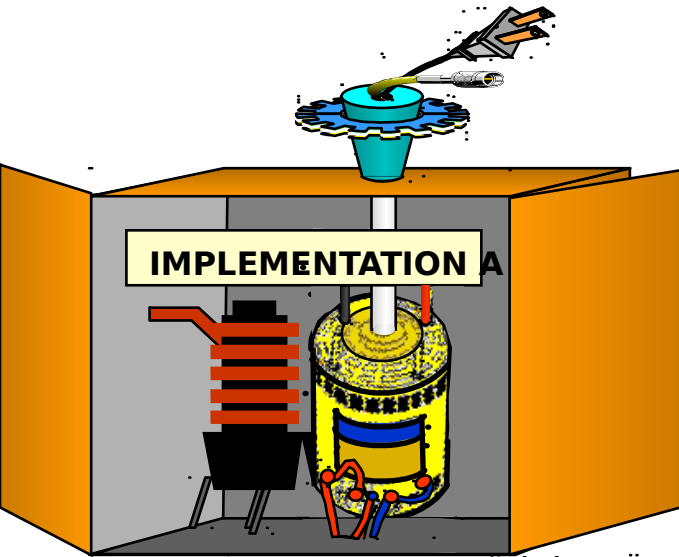




Open Systems Approach



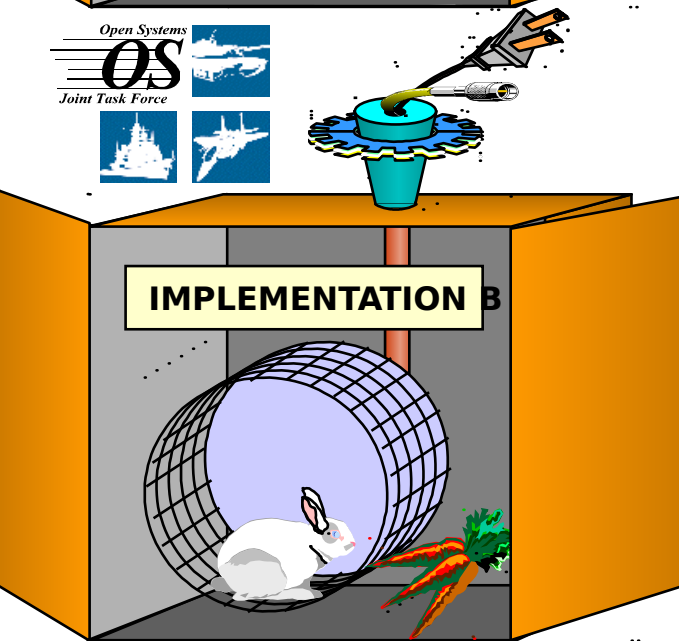
Industry can choose any implementation (including proprietary) to meet OSA interface



Acquisition of System =

Performance Specification +

OSA Interfaces

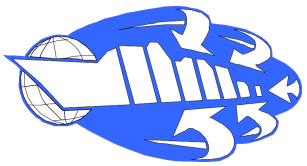


Performance Specification

- Performance
- Envelope
- Human Factors
- Power consumption
- ILS docs

OSA Interfaces

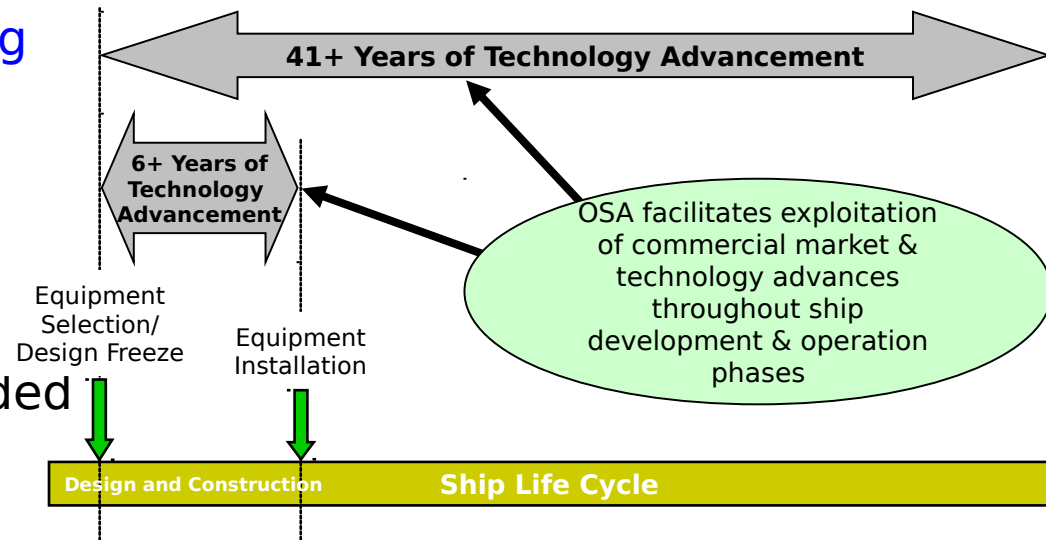
- Physical (Geometric & Tolerances)
- Electrical
- Air interfaces
- Cooling interfaces
- Control Sensors, Monitoring interfaces
- Piping connections
- Human Factors
- Survivability/Vulnerability: shock/vibration/EMI/EMC
- CG / VCG



DoD/Navy Unique Need

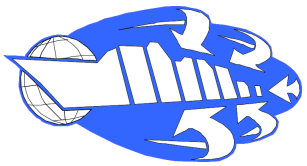


- Platforms with increasingly long lifecycles (30+ years)
- Increased use of commercial technologies
- Short lifecycles of COTS (<7 years)
 - Often obsolete by time fielded



- Increased market “exposure” & small market strength
- Increased emphasis on **Technology Refresh & Insertion**
 - Response to COTS / Market changes
 - Response to Mission changes
 - Response to New Technologies (evolutionary and

OSA is a large component of the answer



Open System Benefits



- **Flexibility**

- Allows access to multiple vendors at system and component level
 - Competition during acquisition and over lifec
 - Avoid sole source constraints

- **Upgradability**

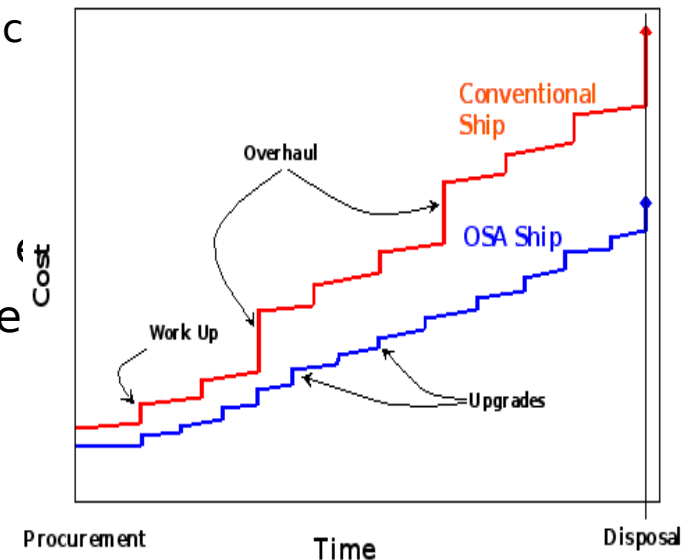
- Allows new technology to be inserted cost
- Does not limit industry's ability to innovate

- **Scaleability**

- For future upgrades

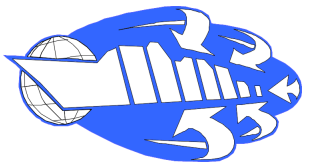
- **Affordability**

- Reduces procurement costs
- Reduces production costs
- Reduces construction costs
- Reduces O&S costs

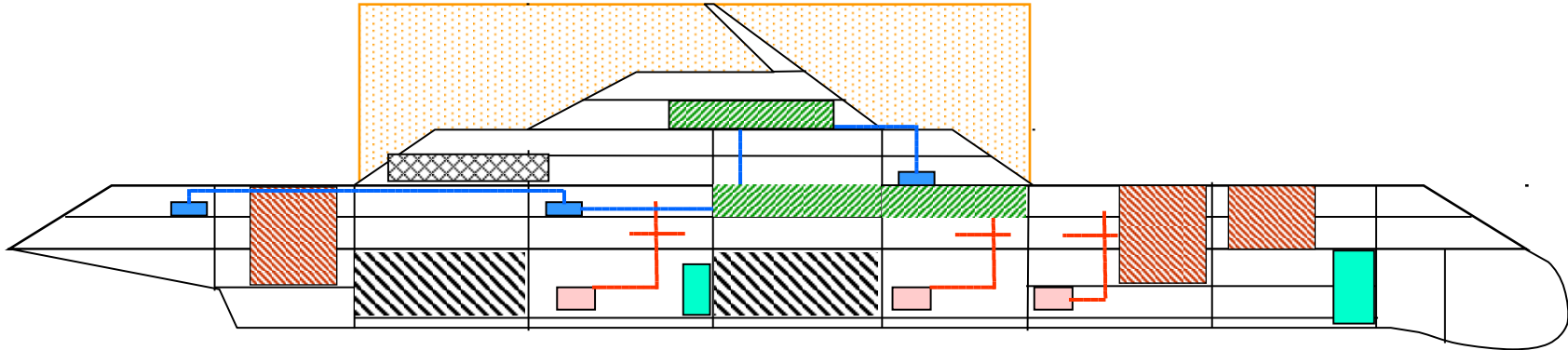


**Projected Cost Savings
based on studies to
date:**

**Acquisition : 20 -
25%**



TOSA Vision: The Adaptable Ship



Open Zones



Ordnance



Machinery Equipment



C4I

Organic Off board Vehicles
(OOV)



Topside



Other



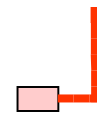
Open Modules

Various

Open Distributed Systems



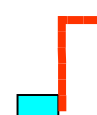
IPS



TSCE



HVAC

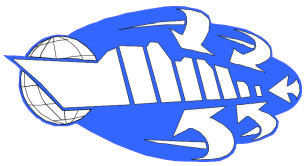


Etc.

+Monitoring

+Maintenance

+Supply



Need for Supply, Maintenance and Monitoring Open Architecture

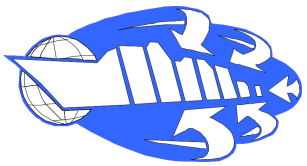


- Increased **operational readiness** – particularly when optimal manning is specified (e.g.DDX).
- Use **Open Standards** for better **Interoperability and technology upgrade & refresh**.
- **Optimal efficiency for shipboard maintenance and supply functions**
 - Condition assessment
 - Condition-Based maintenance
 - Automation of supply functions (such as inventory and parts ordering)
- **Solutions must be acceptable** to both system integrators and component manufacturers for new ships and compatible with on going ISEA programs.



Fleet Support

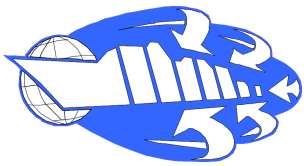




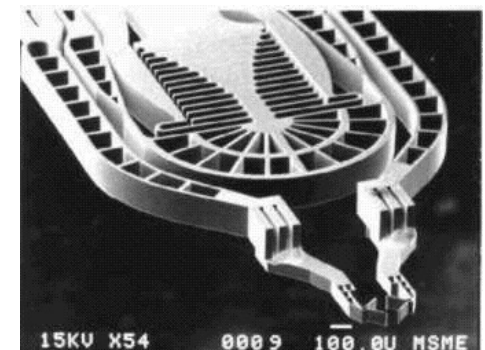
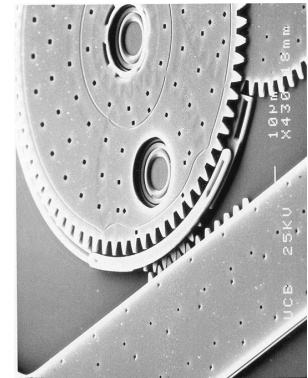
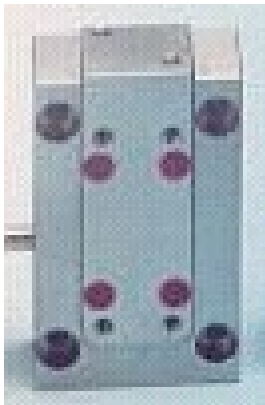
SMMOA Elements

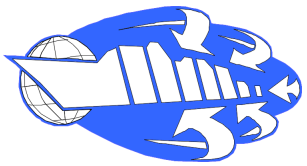


- TOSA has established the following elements as part of the SMMOA Focus Area Team:
 - **Open Sensor/Network Interface** (OSNI) Development
 - **Open Material Condition Information** (OMCI) Development [For Condition Based Maintenance]
 - **Open Logistics Support Interface** (OLSI) Development



Open Sensor/Network Interface (OSNI) Development

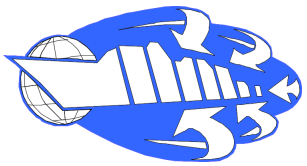




Automation and Open Architecture



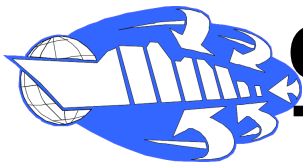
- **Reduced/optimized** manning requirement for future ship classes drives for increased **automation**.
- Increased automation will require a significantly **increased number of transducers** installed aboard ship
 - Possibility of **25,000 (or more)** transducers on DD(x) class of ships
 - Levies unique requirements for future Naval platforms
- **Open architecture** approach will be key to achieving vision of highly automated ship in a cost effective manner
 - Reduced installation costs
 - Allow for Technology Insertion / Upgrade
 - Allow for streamlined Maintenance & Supply



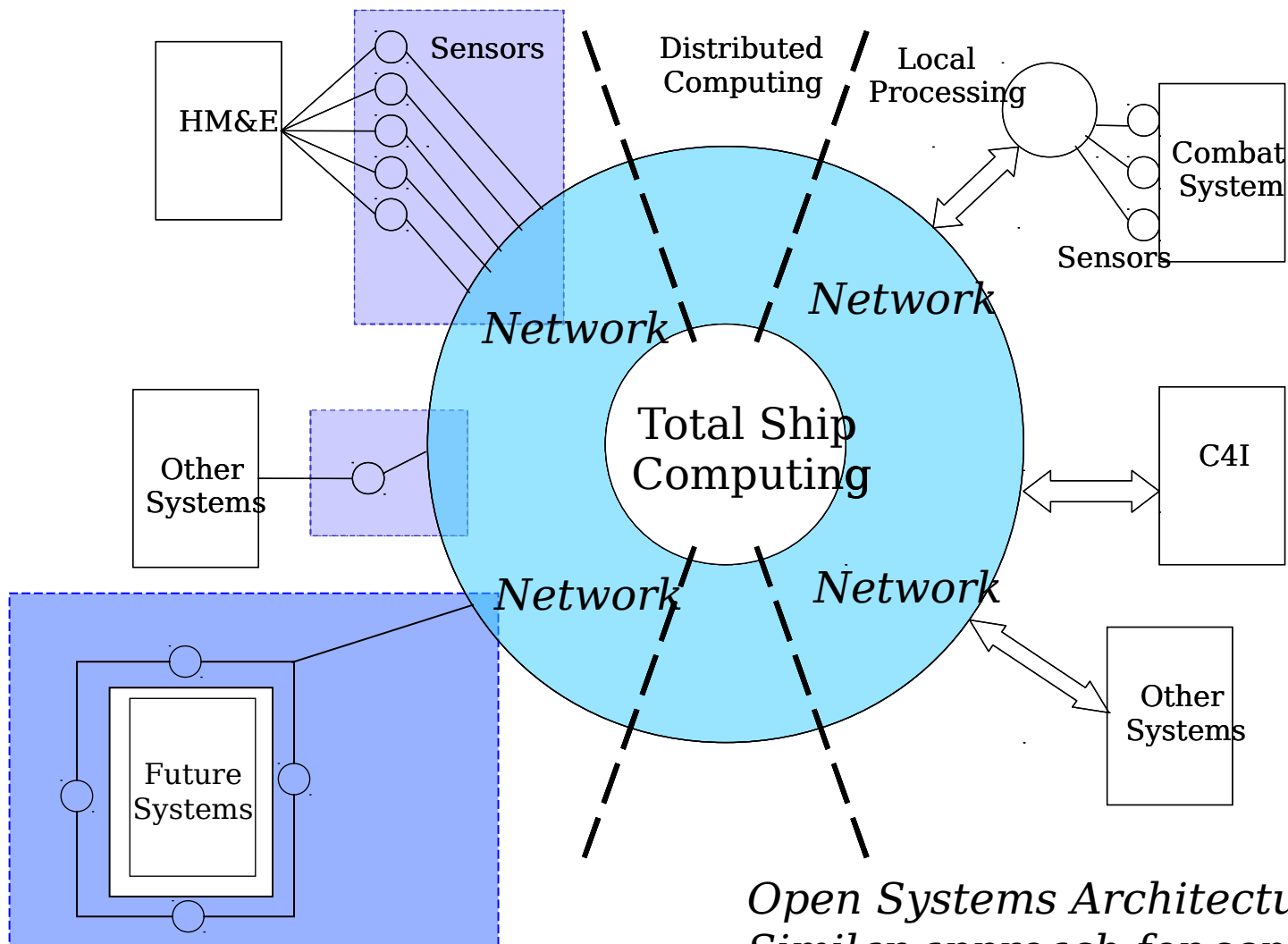
OSNI Goals & Objectives



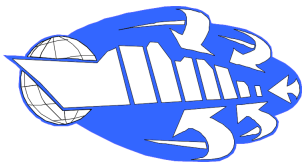
- Explore various **sensor-bus standards & interfaces**
- Perform **Risk Mitigation** on candidate sensor-bus standards
- Help establish a set of **Navy Open Architecture sensor-bus standards & interfaces**
- Work with **Standards Bodies** to develop Open Sensor-Bus Standards for both Industry and Navy
- **Promulgate the use** of sensor-bus standards for Navy systems to shipyards, systems integrators and vendors



Open Sensors/Networks and Total Ship Computing (TSCE)



*Open Systems Architecture Approach
Similar approach for sensors/sensor net*



OSNI Initial Focus on IEEE 1451 Family

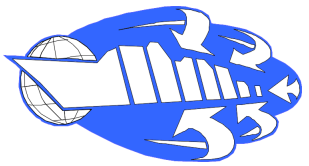


We have chosen our initial focus on the IEEE 1451 family:

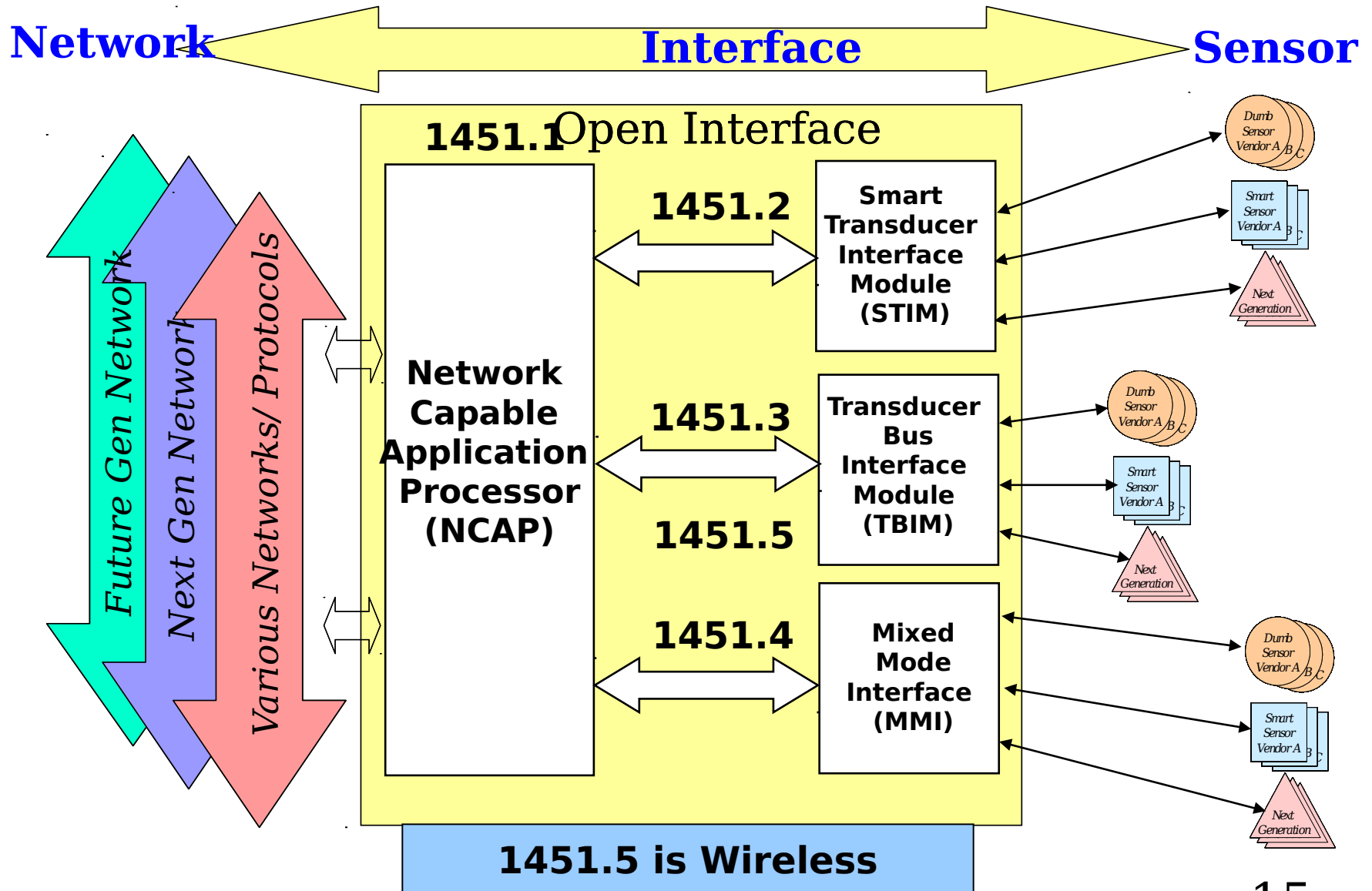
- The IEEE 1451 sensor-bus network family attempts to address interoperability issues
- **1451 family allows for interoperability among different network AND transducer manufacturers**
- 1451 family allows for plug & play of transducers *and* network
- 1451 family allows for easy upgrade
- Development of the 1451 family is evolving

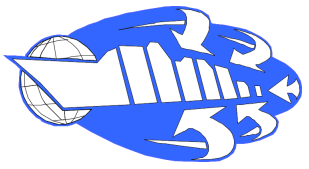
OSNI chose to focus on IEEE 1451 as a candidate

***open interface* sensor/network**

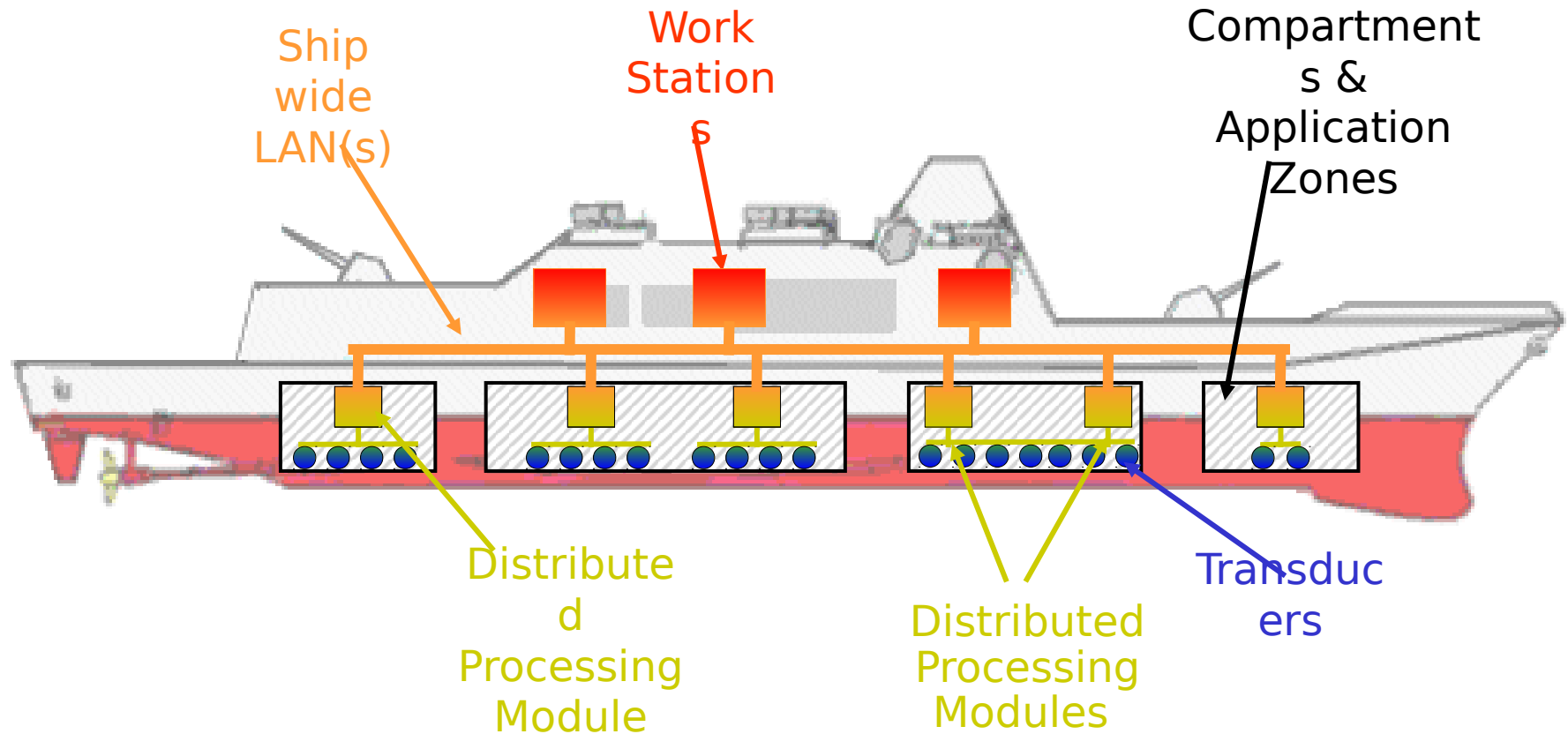


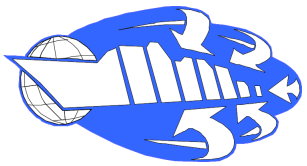
IEEE 1451 Standards Family



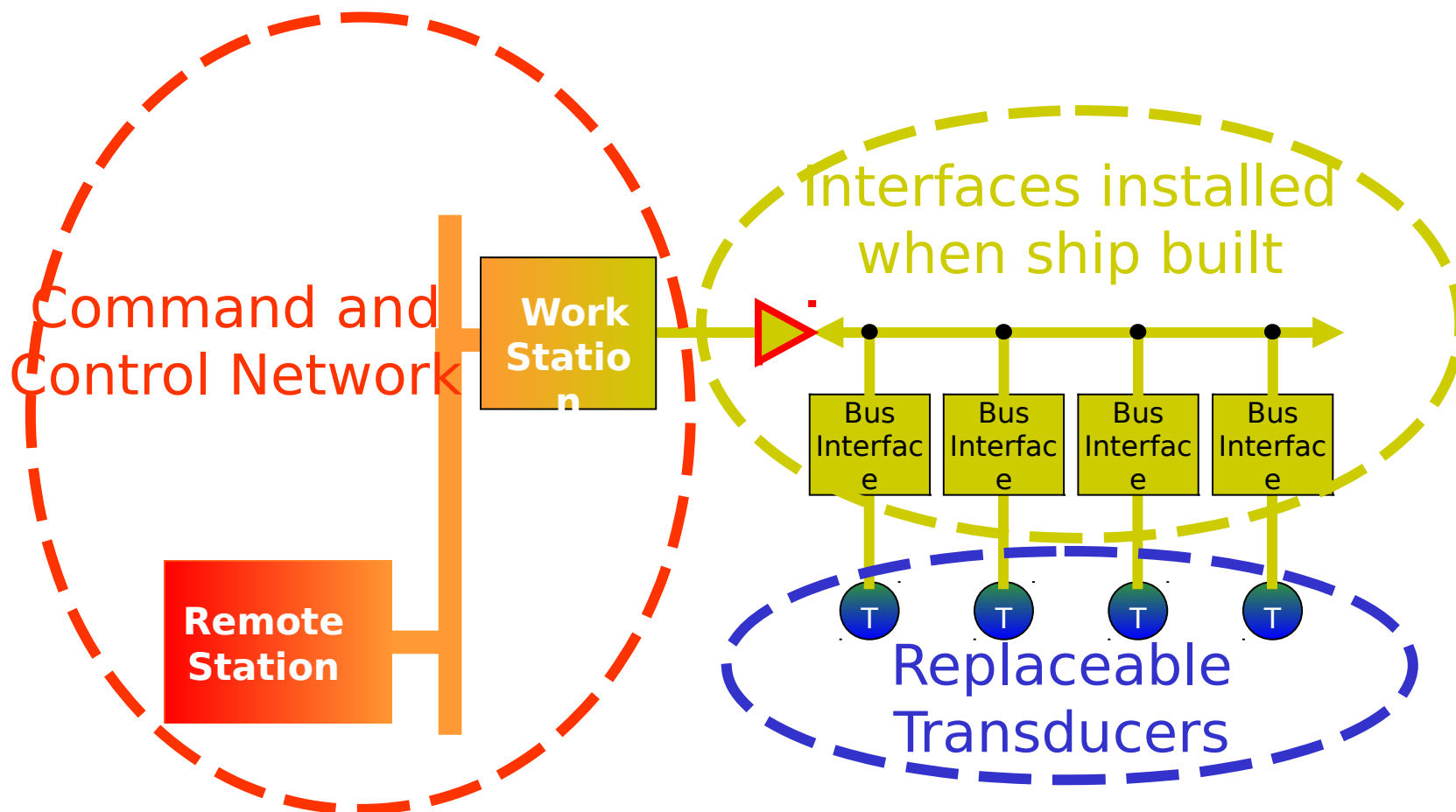


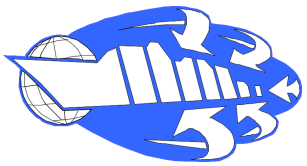
Distributed Sensor-bus Network





Modular Sensor-bus Interfaces

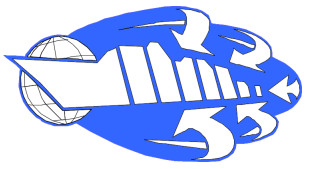




Initial Risk Mitigation



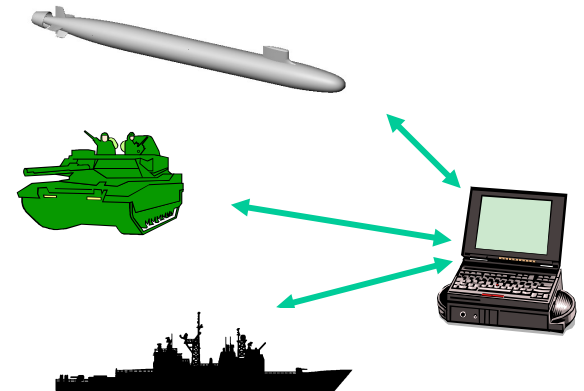
- **Development of an Open Sensor/Network Interface Demonstrator**
 - IEEE 1451.3 (multi-drop bus) chosen for testing
 - Used an early draft of the standard (2001)
 - Examine and explore Navy needs and requirements
 - Tested a concept of additional backup features added to help address Navy specific issues
 - Help demonstrate the use of plug-and-play for sensor-bus networks
 - Adapted existing COTS parts and systems to simulate IEEE 1451.3 network
 - Pressure & Temperature sensors
 - Encoder & Stepper motor actuators

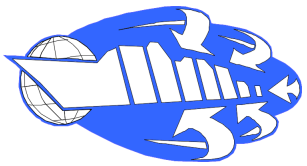


OSNI Demonstrator



Open Material Condition Information (OMCI)



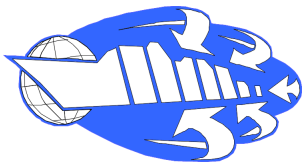


OMCI Requirements

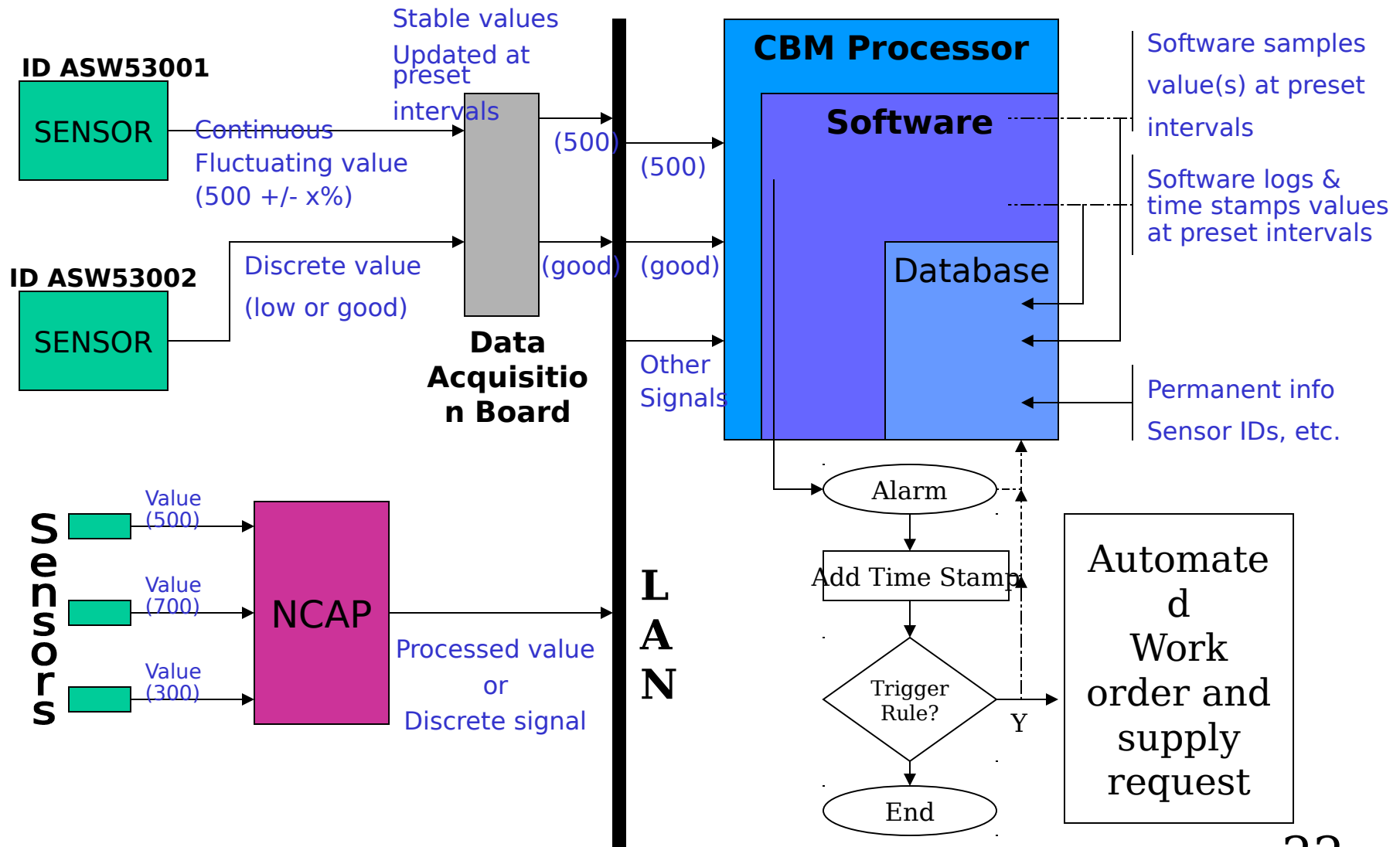


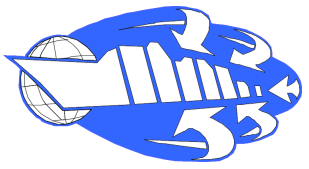
- Need to **reduce/optimize manning** for DDX
- Need to **reduce maintenance man-hours**
- Requires more **Sophisticated and Extensive Maintenance Applications**
- There are **multiple Navy and commercial maintenance information interfaces**
- Maintenance developments *including* future Condition Based Maintenance (CBM) applications require:
 - Access to expanding commercial developments.
 - Interoperability between commercial CBM systems and maintenance information systems.
 - A Navy/commercial standard interface for maintenance ap

An Open Material Condition Information Standard is Required



Material Condition Information Data Flow

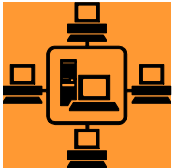




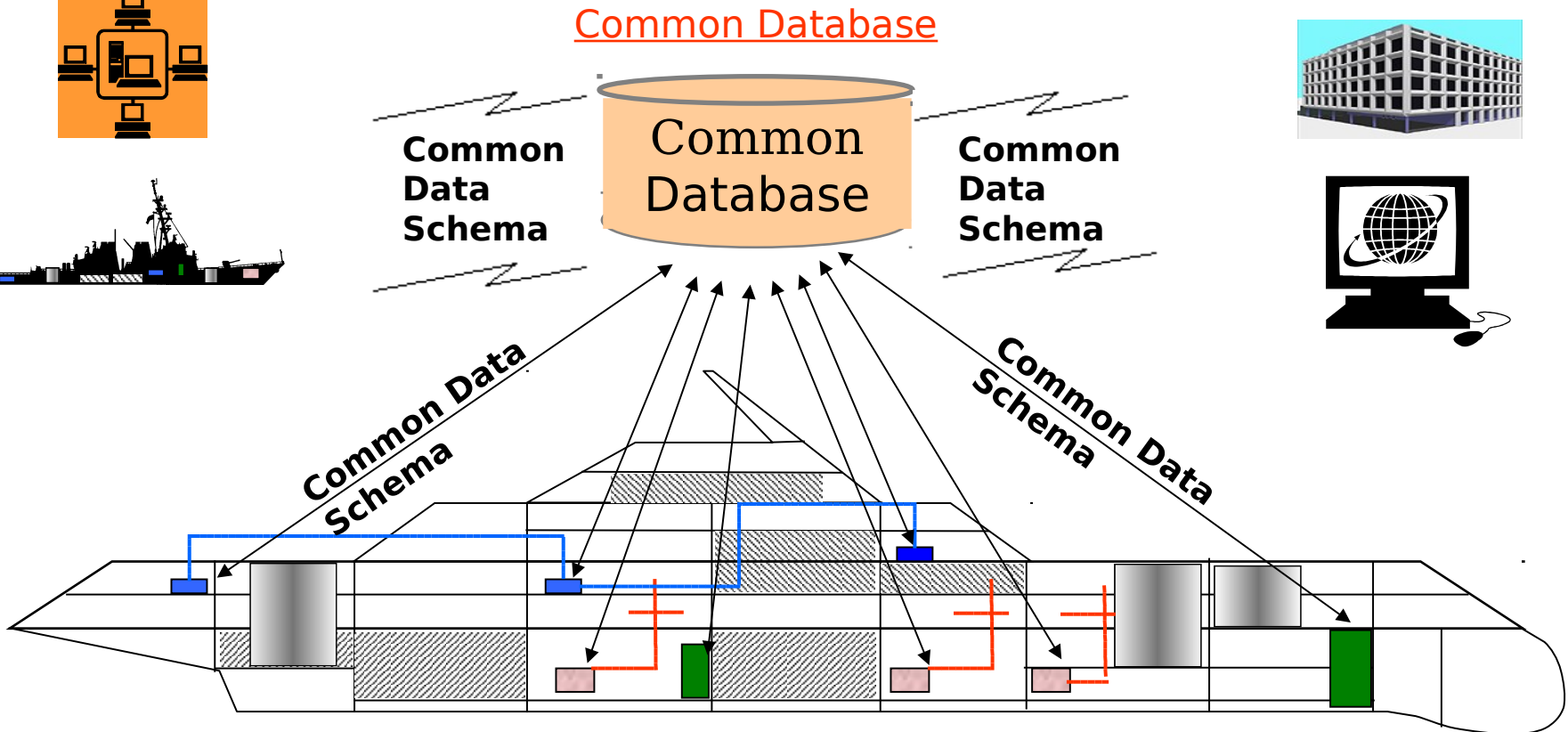
Open Material Condition Information



On-Ship



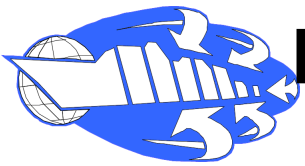
Off Ship



*A common database information schema for all **material condition information**, NOT just CBM data.*

Integration of CBM and Information Systems

Information Interoperability



Military Market Surveillance/ Technology Projection



Navy Development Efforts

- Total Ship Monitoring (**TSM**)
- Battle Group Automated Maintenance Environment (**BG-AME**)
- Enterprise Resource Planning (**ERP**)
- DDX
- Etc.

Working Groups

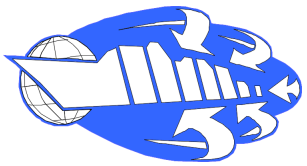
- Gas Turbine Working Group
- Maintenance Engineering Technology Team (SEA04M)
- Joint Wireless Working Group (SPAWAR)

R&D Programs

- Reduce Ships crew through Virtual Presence (**RSVP**)
- SMARTSHIP Initiatives
- Submarine Towed Arrays
- Submarine Maintenance Monitoring Program
- Etc.

Other CBM Data Activities

- Army Diagnostic Improvement Program
- AAV
- JAHUMS
- OSA-CBM
- MIMOSA
- Etc.

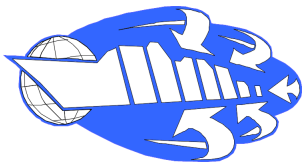


MIMOSA



- Maintenance Information Management
Open Systems Alliance
- Consortium of 50+ system integration providers, component vendors and end-users
- MIMOSA addressing the interoperability deficiency in information integration and exchange.
- Developing open specifications for all material condition information, not just CBM
- MIMOSA goal to become an ***ISO Standard***

**SMMOA Selected MIMOSA as
a Candidate Navy OMCI Standard**



MIMOSA Database Structure



Fixed Reference Data

Engineering Units
Transducer Types
Data Source types
Measurement Location Types

Navy Specific Reference Data

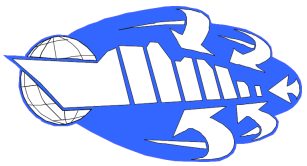
Segments - ESWBS
Assets - EC/LAPL/APL

Ship Specific Reference Data

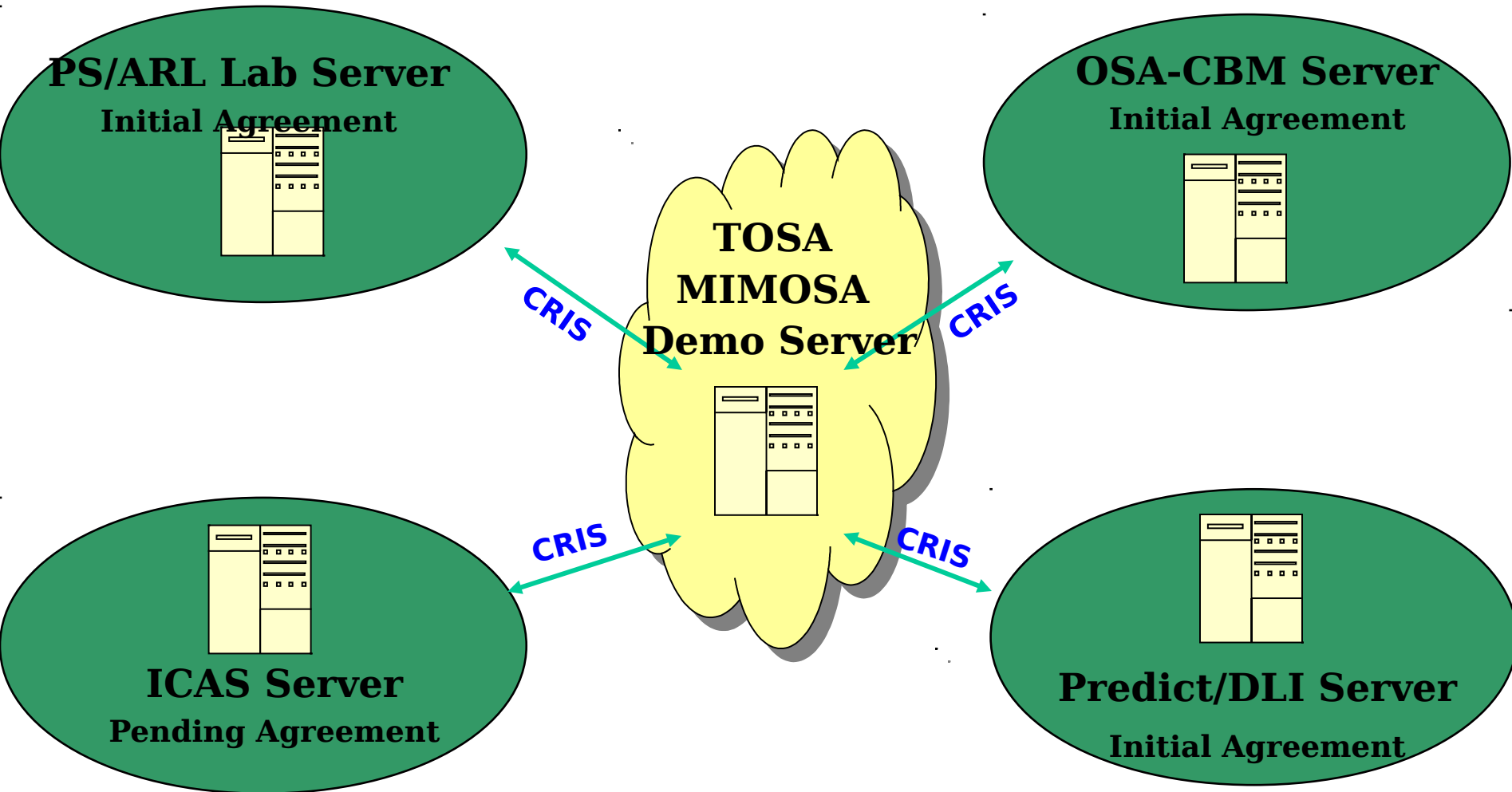
Assets on Segments - CMDM-
OA
Measurement Locations - ICAS
CDS, VTAGS, Thermographic
Routes, Etc.
Pressures

Data Values

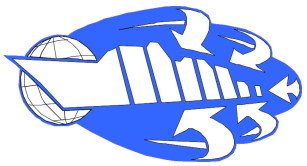
Temperatures
Vibration Signatures



OMCI Server Demonstrator



Goal: Demonstrate Information Interoperability



Open Logistics Support Interface (OLSI)



Transportation Modes

Land

- Rail
- Trucks/trailers



Sea

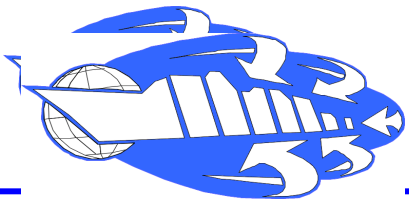
- Ships
- Barges
- Craft



Air

- Fixed Wing
- Helicopter
- Tilt Rotor





New Support Paradigm



Navy Design
Navy CM Control
Full Data Disclosure
Stable Technology
Stable Supplier
Support Bit & Piece
Maintenance
Organic Support

Legacy MILSPEC
Support System

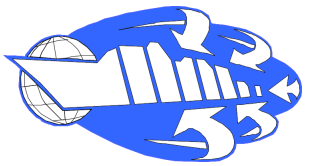
Vendor Design/CM Control
Limited Data Disclosure
Limited Supplier Stability
Rapid Technology Change

COTS Acquisition
(Mid 90's)

Modular Maintenance
Organic/Contractor mix

"TOSA
Enabled"
Acquisition
(Year 2010)

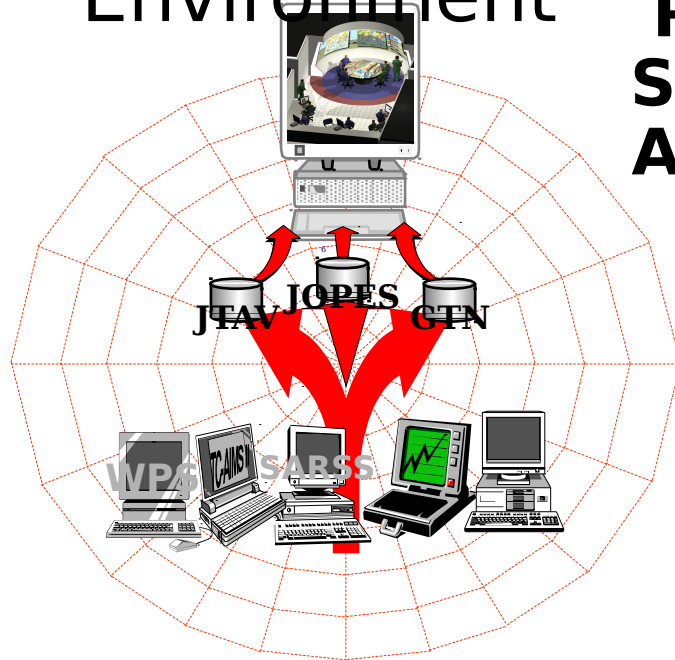
Performance Based
Contracting
Multiple Suppliers
Rapid Tech Insertion
TOSA Interface Specs
Condition Based
Maintenance
Global Information Grid



OLSI Vision

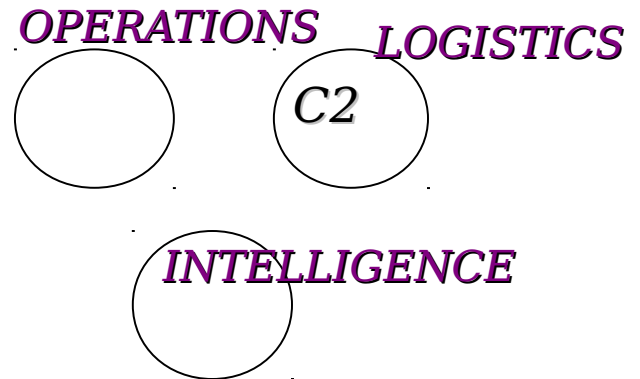


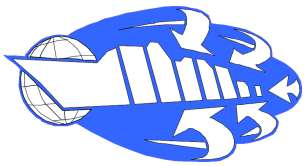
Network Centric
Logistics
Environment



**VADM Holder
Director of
Logistics The**

**Integrated
Real-Time
Situational
Awareness**

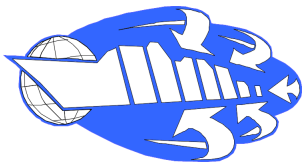




Logistics Requirements



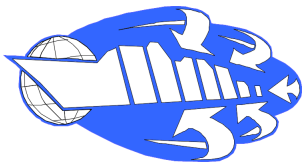
- Reduced Manning
 - Necessary to automate Logistics
- Ability to **see** assets while in storage or transit
 - Streamlined Acquisition & Tracking Management
- Increase Operational Readiness
 - Accountability for necessary items
 - Ability to obtain items from multiple sources
- Utilize Open Standards
 - Increased Life Cycle Support
 - Reduced Total Ownership Costs
 - Interoperability between different systems



OLSI Goals



- Integrate supply support with material condition monitoring and maintenance data bases to enable exchange of data and interoperability
- Advance the use of open standards for critical interfaces
- Enhance asset visibility to reduce cost and enhance readiness
- Automate supply chain management through use of Material Handling Equipment and
Leverage industrial and government best practices, new technology, and emerging standards



Market Surveillance & Technology Projection



- Universal Identification (UID) part marking
- Universal Identification Code
- Smart stores/smart shelves
- Radio Frequency Identification (RFID)
- Ultra Wide Band (UWB)
- Serial Number Tracking
- Data Matrix Symbolology
- Contact Memory Buttons
- AIT networks
- Material handling equipment



Container lifting systems



Characteristics:

Container lifting system stacks containers onto vehicles and ground.

January 3, 2003

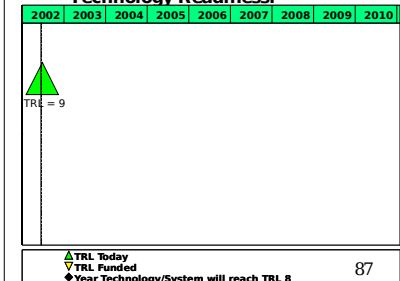
Sponsor/Mfg: Hyster



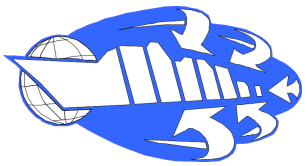
Description

Reach Stackers
Suppliers from
<http://www.hyster.com/dealers/>

Technology Readiness:



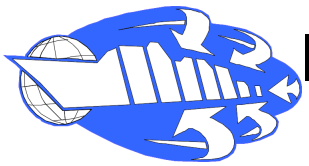
87



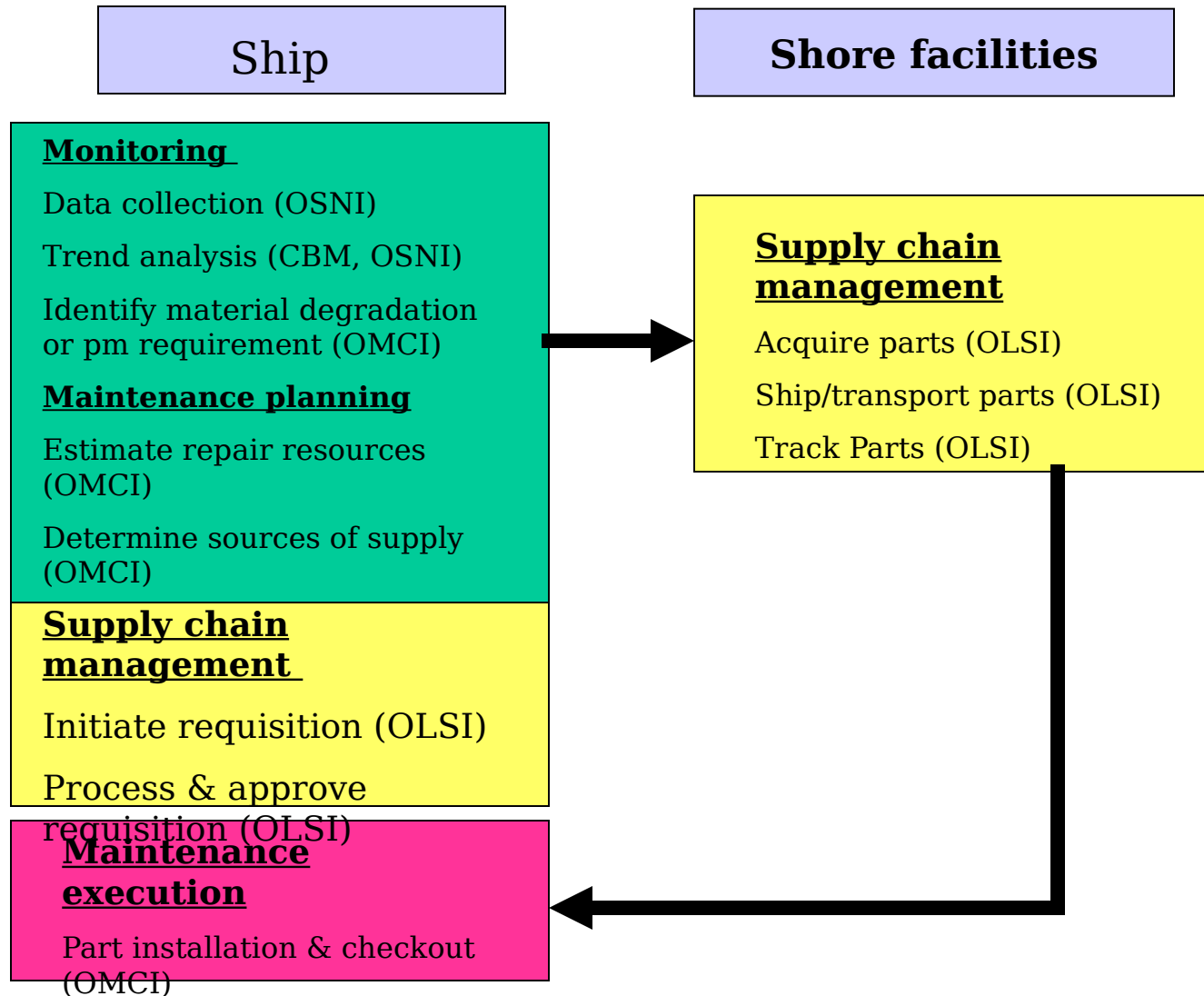
OLSI's Use of Open Standards

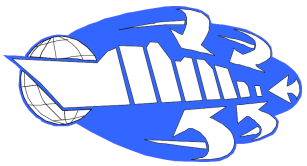


- Review and evaluate evolving standards for AIT, inventory management, MHE, storage & transportation
- Become involved in standards development
 - Better interoperability between systems
 - Insure various Logistics systems communicate with each other
 - From hand-held bar-code readers & CMBs to databases to communications systems

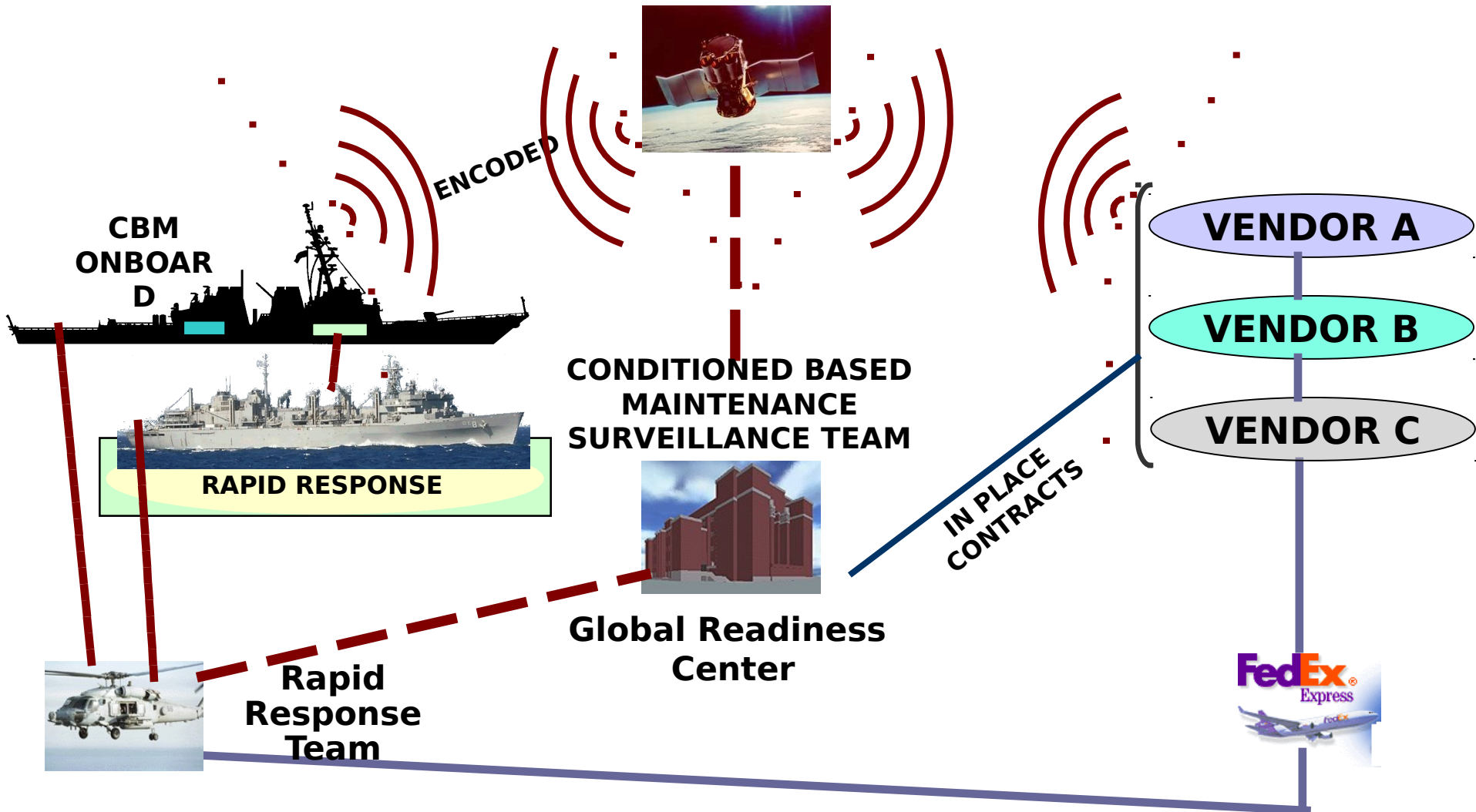


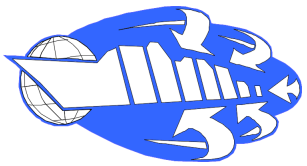
Integrated Supply, Maintenance, and Monitoring Workflow





ILS Scenario Major Unplanned Maintenance

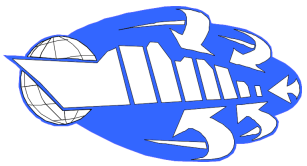




Conclusion



- **SMMOA is a Prime Concern for Navy's future**
 - Future Manning requires better use of technology for monitoring, maintenance and supply
 - Open Standards should be developed/used for interfaces
 - Need risk mitigation on candidate Open Standards
 - Need to reach common Agreements & Strategies
 - Consensus set of Standards for SMMOA
 - Open Sensors, Databases and Supply & Logistics management
 - Promulgate these standards to Naval and Industry Systems Integration Teams



Contact Information



- SMMOA Contacts

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mil

Win Royce

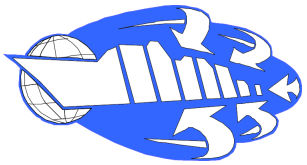
OMCI Lead
(301) 227-7632
RoyceWW@nswccd.navy.
mil

Sam Judge

OLSI Lead
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il

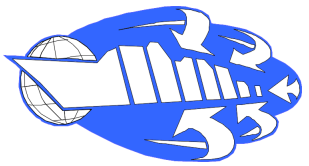
Jack Abbott

TOSA IPT Lead/BlueSky
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mil

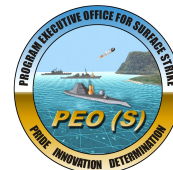


Backup





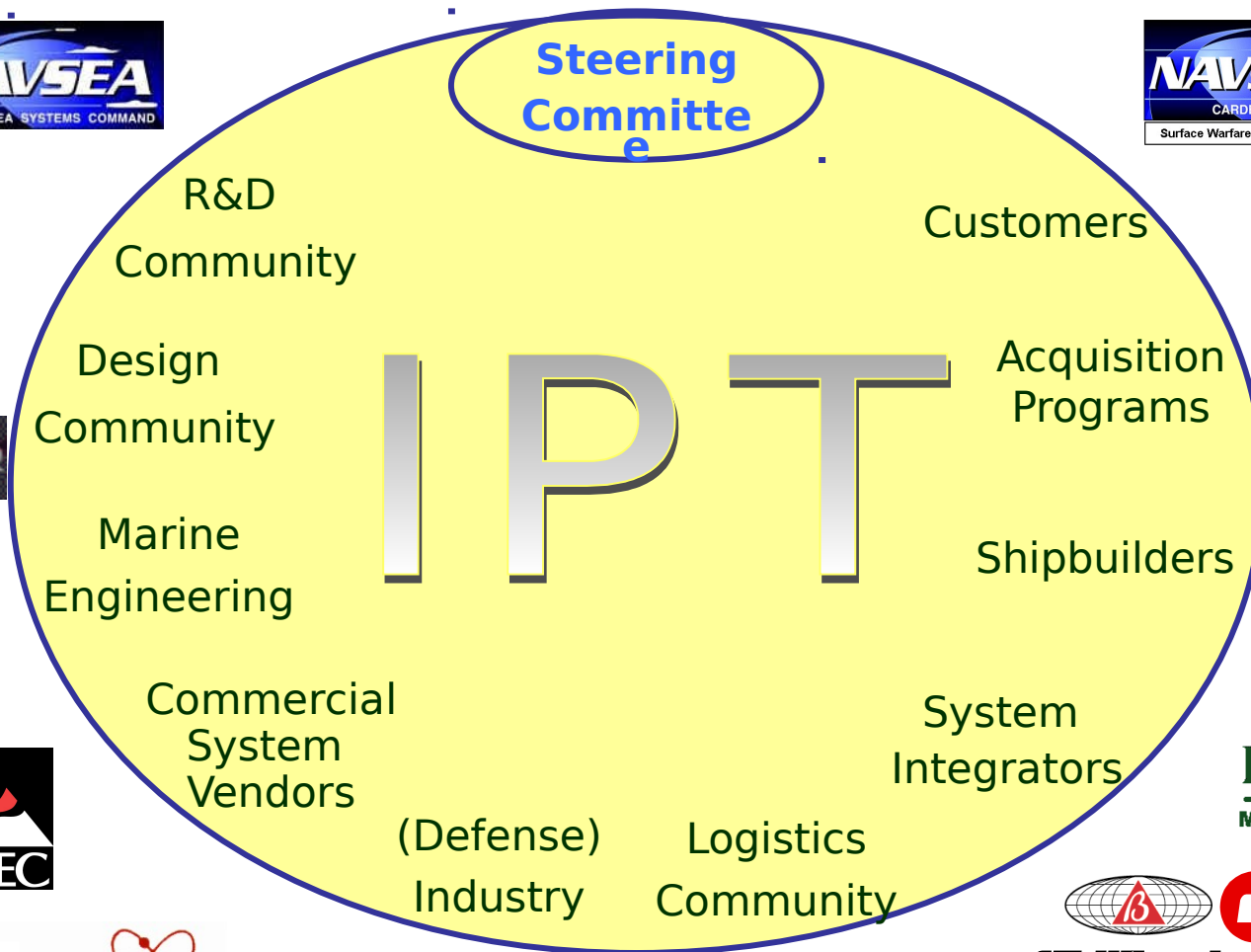
TOSA Industry-Navy Integrated Product Team

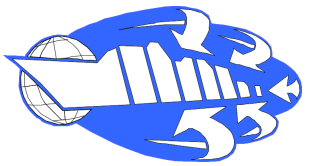


Halliburton Company



Prime, Inc.
M I D A S





OSA Examples



Closed Systems



**Mil-Std 200 ton
A/C Plant**



UYK-44



**Direct Drive
Propulsion**



**A/V-8B
Avionics**

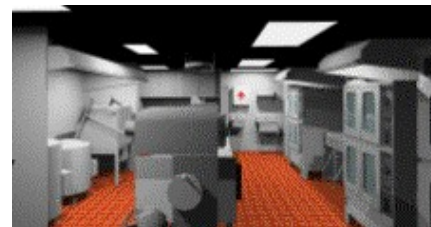
Open Systems



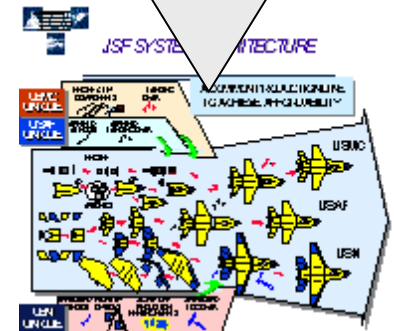
Chilled Water Module



UYQ-70



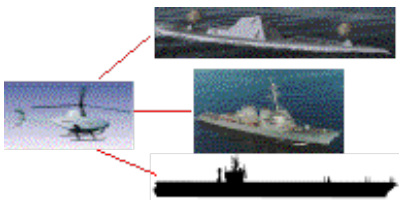
**Advanced Food
Service**



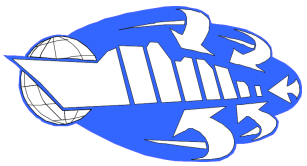
Joint Strike Fighter



Ship Habitability Module



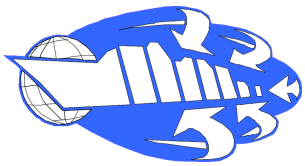
Ship/UAV Interface



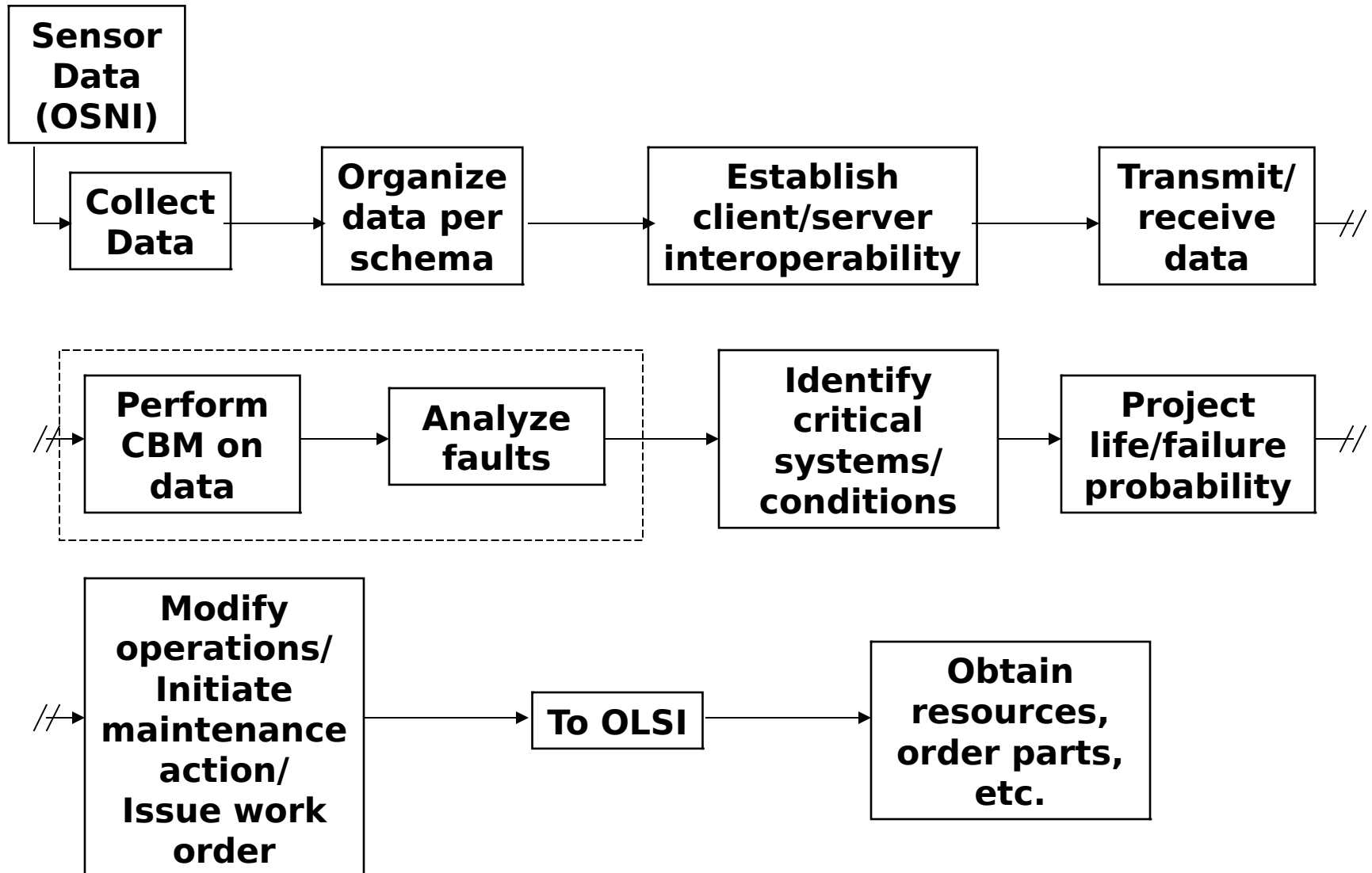
Background/Initial Research

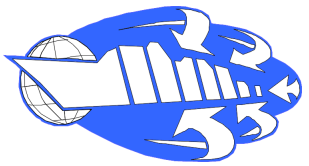


- Began with a comprehensive market surveillance of CBM programs and projects
 - Identified key players and key programs in the CBM arena
 - Identified standards bodies and standards development work with potential TOSA implications
- Established contacts/working relationships with key CBM programs, projects, and companies
 - Commercial companies
 - Navy R&D projects
 - Other military service programs
 - Universities involved in CBM



OMCI Work Flow

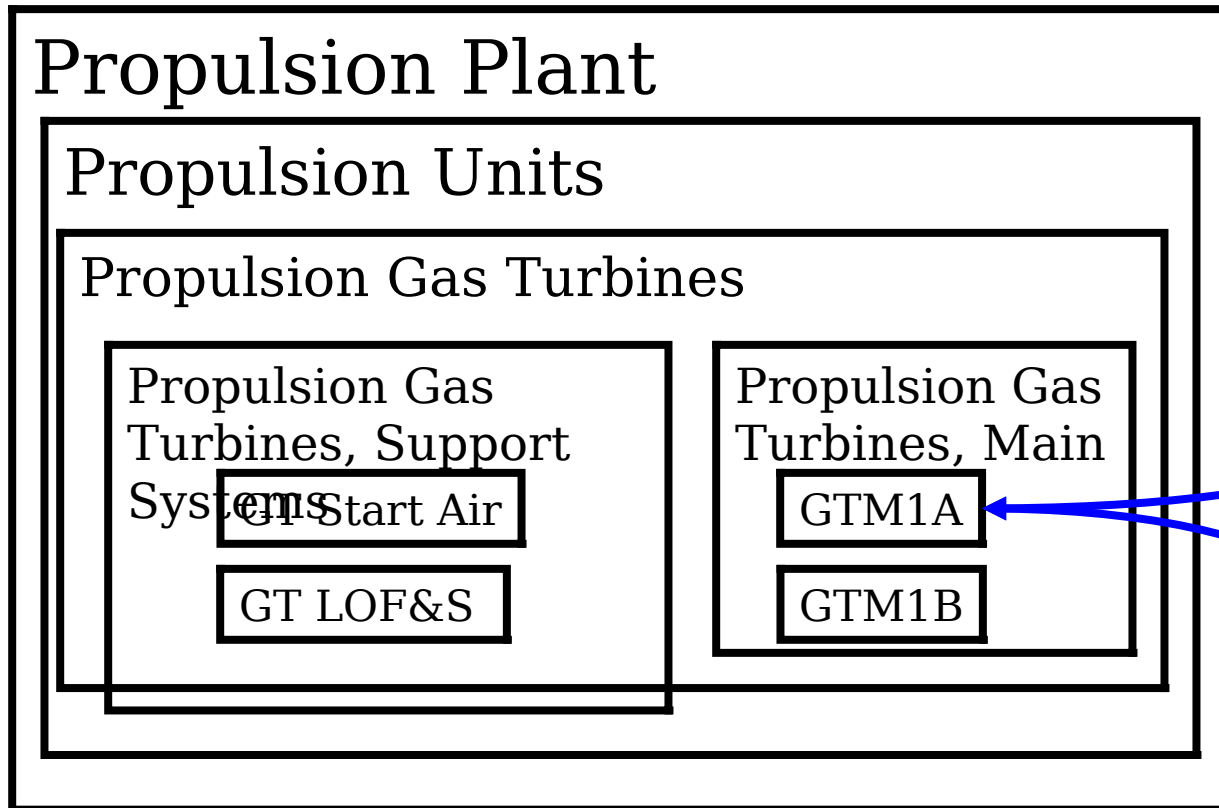




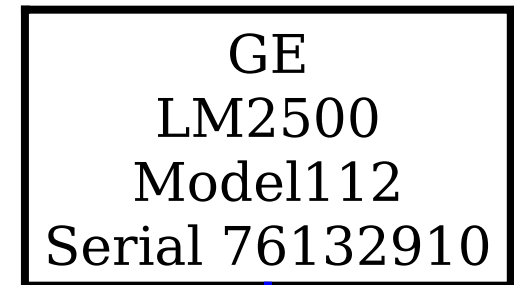
MIMOSA Database Structure



Segments



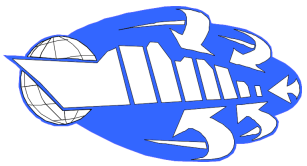
Assets



Asset
On Segment

Measurement
Locations

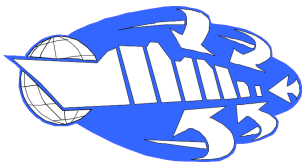




MIMOSA Implementation Issues



- MIMOSA is the gatekeeper for the fixed reference tables
- We need a gatekeeper for the Navy specific reference tables
- MIMOSA DB's ship and shore have to be maintained as ship configuration changes
- Application software is needed to simplify setup of the MIMOSA database
- Hooking up real-time data acquisition to demo server
 - 1451 demonstrator
 - PS ARL
 - Predict DLI
 - ICAS



MIMOSA Interfaces



- MIMOSA defines interfaces for the following “technologies”
 - Trend – static values (pressure or temperature and alarm values)
 - Dynamic – spectral values (vibration, ultrasonic, electric current)
 - Sample – fluid tests such as oil analysis or gas tests
 - BLOB (binary large objects) – graphic files (thermographic or digital camera images)
 - Diagnostic – text values (diagnostics and recommendations)
 - Reliability – FMEA information
 - Registry – asset management information
 - Work – work management information
- MIMOSA Compliance is determined on a technology by technology basis
 - Not all applications use all “technologies “